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REPORT

Young children use their hands to tell their mothers what to say

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Abstract

Children produce their first gestures before their first words, and their first gesture+word sentences before their first word+word sentences. These gestural accomplishments have been found not only to predate linguistic milestones, but also to predict them. Findings of this sort suggest that gesture itself might be playing a role in the language-learning process. But what role does it play? Children's gestures could elicit from their mothers the kinds of words and sentences that the children need to hear in order to take their next linguistic step. We examined maternal responses to the gestures and speech that 10 children produced during the one-word period. We found that all 10 mothers 'translated' their children's gestures into words, providing timely models for how one- and two-word ideas can be expressed in English. Gesture thus offers a mechanism by which children can point out their thoughts to mothers, who then calibrate their speech to those thoughts, and potentially facilitate language-learning.

Introduction

Children enter language hands first. They produce pointing gestures to refer to objects, people, and places well before they produce spoken words for these same referents (Bates, 1976; Bates, Benigni, Bretherton, Camaioni & Volterra, 1979). Children also produce gestures along with words to convey sentence-like meanings well before they produce these meanings entirely in words (for example, a child might point at mother and say 'hat' before producing the two-word sentence 'mommy hat'; Greenfield & Smith, 1976; Ozcaliskan & Goldin-Meadow, 2005). Importantly, these early gestural 'words' and 'sentences' do not merely *predate* their equivalent milestones in speech – they *predict* them (Iverson & Goldin-Meadow, 2005; Goldin-Meadow & Butcher, 2003), suggesting that gesture may be playing a role in the language-learning process itself. But what role does gesture play? The purpose of this paper is to explore one mechanism by which gesture might be influencing the language-learning process.

Consider a child who does not yet know the word 'dog' and refers to the animal by pointing at it. His obliging mother responds, 'yes, that's a dog', thus supplying him with just the word he is looking for. Or consider a child who points at her mother while saying the word 'hat'. Her mother replies, 'that's mommy's hat', thus translating the child's gesture+word combination into a simple sentence. Because they are finely tuned to a child's current state (cf. Vygotsky's, 1986, zone of proximal development), maternal responses of this sort could be particularly effective in teaching children how an idea is expressed in the language they are learning.

This scenario is predicated on the assumption that young children intend to convey particular messages with their gestures and that mothers are sensitive to those messages and respond accordingly. There is evidence in the literature for both assumptions. For example, Golinkoff (1986) found that often when 12- to 16-month-old infants use gesture, they have a particular message in mind – as evidenced by the fact that they negotiate with their mothers over their intended meaning. Similarly, Shwe and Markman (1997) found that 30-month-olds engage in a range of behaviors to ensure that their requests, expressed primarily through gesture, are understood by an experimenter.

Moreover, gesture does not go unnoticed. Adults typically react to the gestures speakers produce along with their talk (Beattie & Shovelton,1999; Driskell & Radtke, 2003; Goldin-Meadow & Sandhofer, 1999; McNeill, Cassell & McCullough, 1994; Thompson & Massaro, 1986),

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often recasting the information conveyed in gesture into speech (Goldin-Meadow, Kim & Singer, 1999; Goldin-Meadow & Singer, 2003) – and mothers of young infants are no exception. Mothers not only respond to the gestures that their young children produce but often translate those gestures into words (Golinkoff, 1986; Masur, 1982).

We ask here whether mothers' translations of their children's gestures have an impact on the child's subsequent language development. We explore this question in 10 English-learning children in the one-word stage previously studied by Iverson and Goldin-Meadow (2005). Iverson and Goldin-Meadow found that the gestures produced by these 10 children had a tight relation to their lexical and syntactic development in two respects: (1) many of the lexical items that each child produced initially in gesture later moved to that child's spoken lexicon; (2) children who were first to produce gesture+word combinations conveying two elements in a proposition (point at bird+'nap') were also first to produce two-word combinations ('bird nap'). We explore here whether the mothers translated their children's gestures into words and, if so, whether those translations were related to the words that subsequently entered the children's vocabularies and the age at which the children first produced two-word combinations.

Method

Participants

Our study focused on the caregivers of the 10 typically developing children (five males, five females) studied by Iverson and Goldin-Meadow (2005). All were from middle- to upper-middle-class monolingual English-speaking families, and all of the primary caregivers were mothers. The mother–child dyads were followed longitudinally, beginning when each child was 10 months and continuing until 24 months. As in Iverson and Goldin-Meadow (2005), we examined the time period between the onset of one-word speech (range 10–14 months) and the emergence of two-word combinations (range 17–23 months). On average, each child was observed eight times (range 5–12).

Procedure

The children were videotaped monthly for approximately 30 minutes each session, interacting with their mother in spontaneous play situations and during a meal or snack time. A large bag of toys was provided by the experimenter, which included items such as a toy telephone, picture books, and farm animals, among others. The children were also free to play with their own toys.

Coding

Coding the children's speech and gestures

We focused on communicative gestures (see Iverson & Goldin-Meadow, 2005, for criteria). Most of the children's gestures were points (with either the index finger or a palm) or hold-ups (holding up an object in the listener's potential line of sight). The referent of these deictic gestures was assumed to be the object indicated (or held up) by the hand.[1] The children also produced conventional gestures (gestures whose form and meaning are either culturally defined, e.g. nodding the head YES, or specified in the context of particular caregiver–child interactions, e.g. smoothing the hands over the hair to mean PRETTY) and ritualized reaches (arm extensions toward a desired object, usually accompanied by repeated opening and closing of the palm, which we translated as GIVE).

We also coded the children's communicative vocalizations; these consisted of either English words (e.g. 'dog', 'hot', 'walking') or patterns of speech sounds consistently used to refer to a specific object or event (e.g. 'bah' for bottle).

Children often refer to objects intermittently; many objects are thus likely to be mentioned in only one observation session. In order to maximize the chances of finding an effect of mothers' translations on the words that subsequently entered their children's vocabularies, we focused on objects that were referred to in more than one session.[2] In addition, we focused on those objects that the children initially referred to in gesture and not speech. We then classified the objects into those that the child continued to refer to in gesture and not speech in subsequent sessions vs. those that the child began to refer to in speech.

All instances in which a gesture was produced co-temporally with speech were classified as gesture+word combinations and divided into two categories based on the relation between the information conveyed in the two modalities: (a) gesture *reinforced* speech by singling out the referent indicated by the accompanying word

[1] It is possible that, at times, children used deictic gestures to refer, not to objects, but to events (e.g. *cat-sleeping* rather than *cat*). Note, however, that in this case the word 'cat' would still be part of the gloss and the results in Figure 1 would be unchanged.

[2] Only 38 (9%) of the 420 references to objects that were referred to initially in gesture and not in speech were mentioned in only one session (excluding the last session since we had no evidence one way or the other about whether words for objects first mentioned in this last session had entered the child's vocabulary). Even if we include these references in our analyses, we still find that the words for objects whose gestures were followed by maternal translations were more likely to enter the child's vocabulary than the words for objects whose gestures were not followed by maternal translations (.69, $SD = .22$, vs. .59, $SD = .21$, $F(1, 9) = 4.8$, $p = .06$).

(e.g. pointing to flowers while saying 'flowers' to indicate flowers on the table); (b) gesture *supplemented* speech by providing a different but related piece of information about the referent (e.g. pointing to a picture of a bird while saying 'nap' to indicate that the bird in the picture is sleeping).

Reliability was assessed by having a second coder transcribe and categorize the children's speech and gesture. Agreement between coders was 93% ($N = 639$) for isolating gestures, 92% ($N = 119$) for classifying object references by modality of production, and 100% ($N = 52$) for classifying gesture+word combinations as *reinforcing* or *supplementary*.

Coding maternal responses to the child's gestures

All of the speech that the mothers produced during the observation sessions was transcribed. We focused on mother's immediate responses to child utterances containing gesture, noting whether mother produced a word that could be considered a 'translation' of the child's gesture right after the child produced that gesture. We were generous in classifying mothers' words as translations of child utterances. For example, if mother referred to a dog that the child pointed at (but did not name) as 'dog', 'pet', or 'animal', mother's label would be classified as a translation of that pointing gesture.

Hearing a multi-word sentence after producing a gesture+word combination (e.g. point at bird + 'nap') might provide the child with a good model for how to expand the word ('nap') into a two-word sentence ('bird nap'). We therefore noted the number of words that mothers produced per sentence in their responses to the child's utterances, and calculated Mean Length of Utterance (MLU; cf. Brown, 1973). We assumed that a relatively long sentence targeted to the child's gesture+word combination would provide useful information about how to express that idea in a sentence form.

Reliability was assessed by having a second coder transcribe and categorize the mothers' responses to the children's communications on a subset of the data. Agreement between coders was 98% ($N = 81$) for identifying words in mothers' speech as translations of a child's gesture, and 93% ($N = 257$) for identifying the number of words mothers produced per sentence.

Results

Object reference in gesture and early lexical development

In the early observation sessions, the children tended to use gesture (either a pointing gesture or a hold-up) to refer to objects rather than naming them. On average, 75% of the objects to which the children referred appeared initially in gesture and not speech. The children learned the verbal equivalents of two-thirds of these gestures during our observations; these verbal equivalents entered the child's vocabulary on average 3.0 (SD = .54) months after the child first produced the gesture. Did the way in which a mother responded to her child's gestures play a role in determining which verbal equivalents would enter the child's vocabulary?

We looked first at the observation sessions during the period when a child referred to a particular object only in gesture and never in speech. We then divided those gestures into gestures mother translated into speech ($M = 11.8$, SD = 5.92) and gestures mother did not translate ($M = 27.3$, SD = 14.38), and calculated how likely the verbal equivalents of the gestures in each of these two categories were to enter the child's vocabulary.[3] Figure 1A (left-hand bars, top graph) presents the data. The verbal equivalent of a child's gesture was significantly more likely to enter the child's vocabulary when mother *translated* the gesture ($M = .77$, SD = .21) than when she *did not translate* the gesture ($M = .65$, SD = .22) $F(1, 9) = 10.06$, $p = .01$).[4] In other words, when mother translated her child's gestures into words, those words were more likely to become part of the child's spoken vocabulary.

We find the same effect if we begin by dividing the children's gestures into those whose verbal equivalents entered the child's vocabulary during our observations ($M = 11.1$, SD = 12.4) and those whose verbal equivalents did not enter the child's vocabulary ($M = 30.5$, SD = 15.1). We then calculated how often mother responded with translations to the gestures in each of these two categories prior to the time her child produced the word.[5] Figure 1B (left-hand bars, bottom graph) presents the data. Mothers were significantly more likely to have translated gestures whose verbal equivalents *became* part of the child's spoken vocabulary during our observation sessions ($M = .36$, SD = .08) than gestures whose verbal equivalents *did not*

[3] If mother translated any of the gestures that the child produced before its verbal equivalent entered the child's vocabulary, we classified the verbal equivalent of that gesture as having been translated into speech. On average, mothers translated a gesture into a word 1.13 (SD = .41) times for words that entered the child's vocabulary vs. .36 (SD = .26) times for words that did not enter the child's vocabulary.

[4] Proportional data in this and all subsequent analyses were subjected to an arcsine transform before statistical analysis.

[5] On average, children produced a gesture for a verbal equivalent that entered the child's vocabulary 2.50 (SD = .80) times before producing the word in speech, compared to 3.08 (SD = 2.40) times for gestures whose verbal equivalents did not enter the child's vocabulary ($F(1, 9) = .85$, *ns*), thus providing mother with an equal number of opportunities to translate gestures in the two categories.

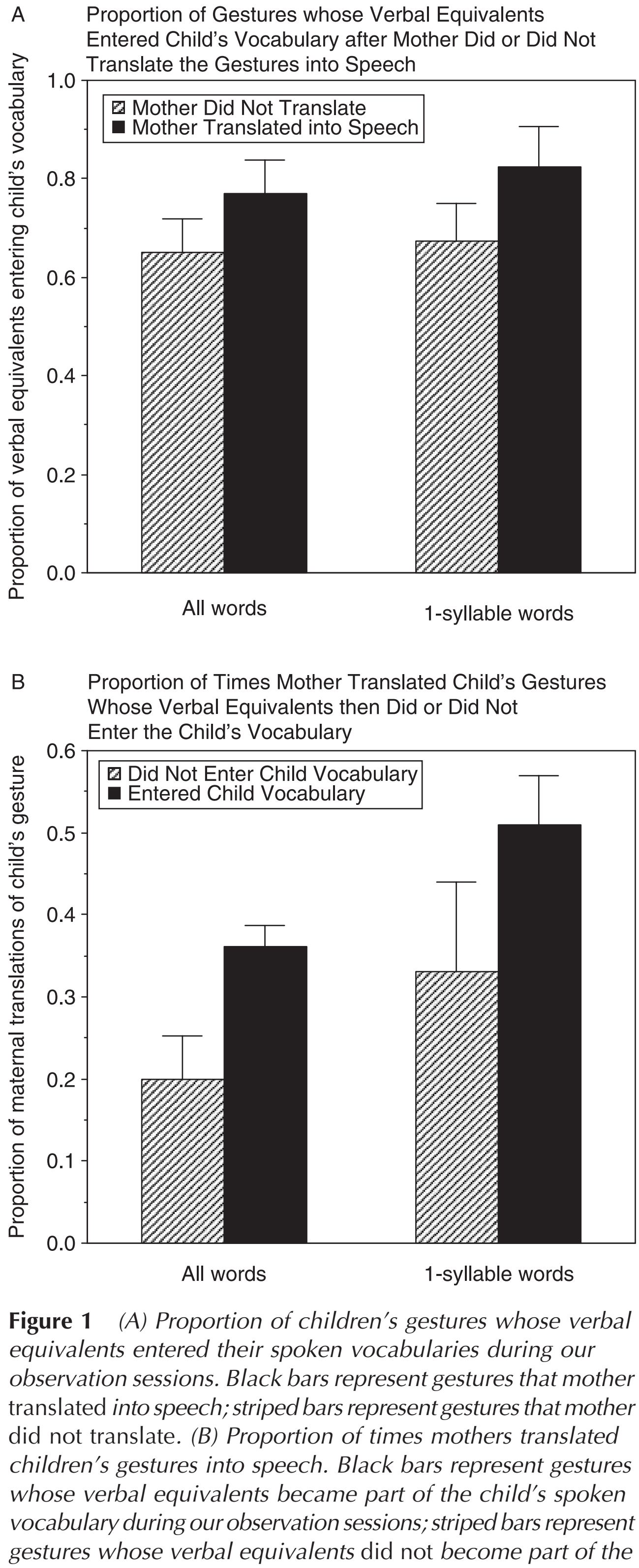

Figure 1 *(A) Proportion of children's gestures whose verbal equivalents entered their spoken vocabularies during our observation sessions. Black bars represent gestures that mother* translated *into speech; striped bars represent gestures that mother* did not translate. *(B) Proportion of times mothers translated children's gestures into speech. Black bars represent gestures whose verbal equivalents became part of the child's spoken vocabulary during our observation sessions; striped bars represent gestures whose verbal equivalents* did not *become part of the child's spoken vocabulary. Data in the left-hand panels of both graphs come from all of the words in the analysis; data in the right-hand panels are restricted to one-syllable words.*

become part of the child's vocabulary ($M = .20$, SD = .17; $F(1, 9) = 7.86$, $p = .02$).

It is possible, however, that mothers were particularly likely to translate gestures whose verbal equivalents were short and therefore easy to produce and learn. Indeed, the verbal equivalents of the gestures mothers translated had, on average, fewer syllables than the verbal equivalents of the gestures she did not translate (1.16, SD = .15, vs. 1.42, SD = .26; $F(1, 9) = 9.98$, $p = .01$). Moreover, the words that became part of the child's vocabularies had fewer syllables than those that did not (1.21, SD = .16, vs. 1.43, SD = .28, $F(1, 9) = 6.12$, $p = .03$). However, when we control for syllable length (i.e. we look only at one-syllable words) in the two analyses displayed in Figure 1, we find the same effects – gestures with one-syllable verbal equivalents that mother *translated* into speech were more likely to enter the child's vocabulary ($M = .83$, SD = .25) than gestures with one-syllable verbal equivalents that mother *did not translate* ($M = .67$, SD = .08; $F(1, 9) = 7.45$, $p = .02$; Figure 1A, right-hand bars); and mothers translated gestures whose one-syllable verbal equivalents *became* part of the child's vocabulary ($M = .51$, SD = .18) more often than gestures whose one-syllable verbal equivalents *did not become* part of the child's vocabulary ($M = .33$, SD = .34; $F(9) = 4.52$, $p = .06$, Figure 1B, right-hand bars).

Words that are part of a child's comprehension vocabulary are likely to enter his or her spoken vocabulary sooner than words that are not. If the mothers were particularly likely to translate gestures whose verbal equivalents were part of their children's comprehension vocabularies, then maternal translations may not have caused children to learn these words but merely reflected their readiness to do so. We had comprehension data (scores on the CDI; Fenson, Dale, Reznick, Thal, Bates, Hartung, Pethick & Reilly, 1993) on six children in our sample. The mothers of these children translated 50% of the gestures whose verbal equivalents were in their child's comprehension vocabulary, but they also translated 42% of the gestures whose verbal equivalents were *not* in their child's comprehension vocabulary. Moreover, if we restrict the analyses displayed in Figure 1 to gestures whose verbal equivalents were *not* part of the child's comprehension vocabulary at any point during our observations, we find the same effects for four of these children (the remaining two children produced fewer than two gestures whose verbal equivalents were not part of their comprehension vocabularies and thus could not be included in the analysis) – gestures that mother *translated* into speech were more likely to enter the child's vocabulary ($M = .88$, SD = .25) than gestures that mother *did not translate* ($M = .47$, SD = .19, $F(1, 3) = 17.29$, $p = .025$), and mothers translated gestures whose verbal equivalents *became* part of the child's vocabulary more often ($M = .62$, SD = .15) than gestures

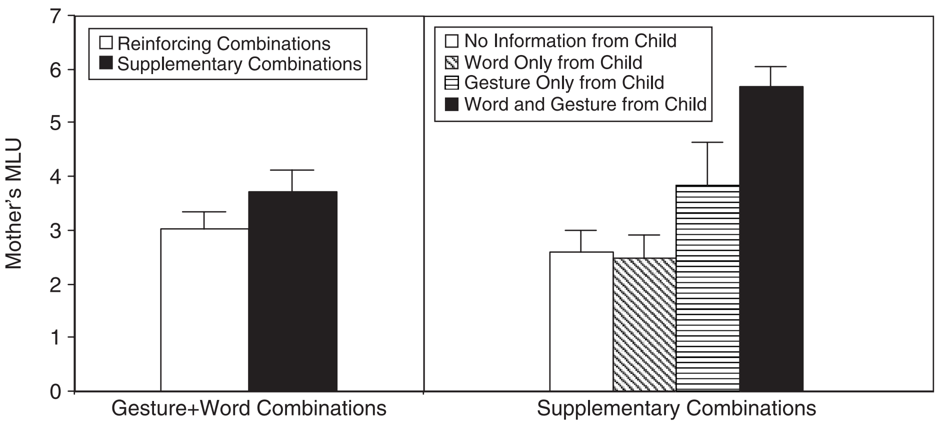

Figure 2 *Mean length of utterance (MLU) of sentences mothers produced in response to children's gesture+word combinations. The left-hand panel presents MLUs for maternal responses to the children's supplementary (black bar) vs. reinforcing (white bar) combinations. The right-hand panel re-presents MLUs for maternal responses to supplementary combinations, this time divided according to how much of the child's message mother incorporated into her response: no information from child (white bar), information conveyed in the child's word (diagonal striped bar), information conveyed in the child's gesture (horizontal striped bar), or information conveyed in both the child's word and gesture (black bar).*

whose verbal equivalents *did not become* part of the child's vocabulary ($M = .10$, SD = .20; $F(1, 3) = 17.99$, $p = .024$).[6]

To summarize thus far, when mothers produced words in response to the gestures that their children produced without speech, the children later added those words to their vocabularies. The children's gestures thus provided a signal to the mothers, who responded accordingly. We ask next whether mothers were similarly responsive to their children's gesture+word combinations.

Gesture+word combinations and the transition to two-word speech

All of the children produced both *reinforcing* (e.g. point at bird + 'bird') and *supplementary* (e.g. point at bird + 'nap') gesture+speech combinations before they produced their first two-word combination ('bird nap'). If mothers understand and respond to the gesture a child produces in a gesture+word combination, they might be expected to produce longer utterances in response to supplementary as opposed to reinforcing combinations simply because there is more information conveyed in a supplementary combination (*bird* and *nap*) than in a reinforcing combination (*bird*). To explore this possibility, we calculated MLUs for sentences that the mother produced in response to her child's supplementary combinations, and compared them to MLUs for sentences produced in response to the child's reinforcing combinations. We found that mothers' MLU was indeed significantly longer in their responses to children's supplementary combinations ($M = 3.73$, SD = 1.26) than in their responses to children's reinforcing combinations ($M = 3.03$, SD = .95) $F(1, 9) = 6.56$, $p = .03$; see Figure 2, left-hand panel).

This effect is even more striking if we look at the kinds of sentences mothers produced in response to their children's supplementary combinations. Mothers' sentences were longest (MLU = 5.68) when they incorporated into their subsequent response information that their children had conveyed in both speech and gesture (e.g. 'the *bird*'s taking a *nap*'; Figure 2, right-hand panel). Note that the mothers could have produced five-word-long sentences even if they had not gleaned *all* of the information the child conveyed but had picked up only the information the child conveyed in speech ('It's time for your *nap*') or gesture ('It's just like grandma's *bird*'), or even if they had picked up none of the information the child conveyed (e.g. 'Let's read the other book'). But they didn't. Mothers' MLUs differed as a function of how much information they gleaned from the child's supplementary combinations ($F(3, 12) = 6.50$, $p < .01$) and were significantly longer when the mothers gleaned information from the child's speech *and* gesture (MLU = 5.68) than when they gleaned information

[6] Another related possibility is that mothers were more likely to translate children's gestures that were unambiguous, perhaps because the children themselves were less uncertain about the referents of these gestures. If so, then maternal translations might not have caused children to learn the words for these referents, but merely reflected the children's readiness to do so. However, we found no evidence that mothers preferentially translated children's gestures that were clear and unambiguous. We showed 14 gestures that mothers translated and 14 that they did not translate to nine adults naïve to the hypotheses of our study, and asked the adults to identify the referents of the gestures. The adults correctly identified *fewer* referents for gestures that mothers translated than for gestures they did not translate (9.22, SD = .1.64, vs. 12.44, SD = .88), providing no support for the hypothesis.

from either speech (MLU = 2.49, $p < .01$, Newman-Keuls) or gesture (MLU = 3.82, $p = .05$) or when they gleaned no information at all from the child (MLU = 2.59, $p < .01$).[7]

It is important to recognize that mothers' increased MLUs were targeted to particular utterances that their child produced, and not to the child's overall state. Mothers might have begun producing longer utterances when they sensed that their child was ready to hear them – that is, around the time that the child first produced supplementary gesture+word combinations (which entered the child's repertoire later than reinforcing combinations, Iverson & Goldin-Meadow, 2005). But, in fact, mothers' MLUs were no higher after their children began producing supplementary combinations than they were before (3.79, SD = 1.07 *after* vs. 4.40, SD = 1.14 *before*, $F(1, 9) = .08$, *ns*). Mothers increased the length of their sentences selectively in response to particular gesture+speech combinations that their children produced.

Hearing 'the bird is taking a nap' after pointing at a bird and saying 'nap' might indeed encourage a child to produce her first two-word sentence. To explore this possibility, we correlated the age at which a child produced her first two-word utterance with the proportion of translation responses that the child's mother produced during our observation sessions. Maternal translations were taken as a proportion of mother's responses to all of her child's gestures that were not accompanied by a reinforcing word (e.g. point at bird; point at bird + 'nap'), with the exception that we eliminated from the denominator child utterances to which mother gave no response at all. On average, children produced their first two-word utterance at 19.3 months (SD = 1.9, range 17 to 23 months), and mothers produced translations of .28 (SD = .14, range 0 to .42) of the gestures that their children produced without a reinforcing word. We found that children whose mothers produced a large proportion of translation responses were first to produce two-word utterances ($r_s = .93$, $p < .01$, Spearman Rank Correlation Coefficient), suggesting that the mothers' targeted responses to their children's gestures might have played a role in helping the children take their first step into multi-word combinations.

It is possible, however, that mothers who produced a large proportion of translations also talked a great deal and that amount of talk, rather than translations, was responsible for the onset of two-word sentences in the children. To test this hypothesis, we calculated the mean number of utterances mothers produced per hour and correlated that number with the onset of two-word sentences in the children. We found that the two measures were unrelated ($r_s = .21$, *ns*), providing no support for the hypothesis.

To summarize briefly, mothers translated their child's gestures into words, providing timely input for the child's acquisition of both object names and multi-word sentences.

Discussion

Young language-learning children often reveal what is on their minds through gesture and not speech (Goldin-Meadow, 2003). Our findings confirm earlier reports (e.g. Golinkoff, 1986; Masur, 1982) that mothers respond to the gestures their children produce, frequently translating them into words. However, our findings take the phenomenon one step further by showing that mothers' translations are related to later word- and sentence-learning in their children. Note that we are not claiming that maternal responses are solely responsible for the learning effects in the children. Rather, our hypothesis is that the children's readiness to learn a word or sentence, as evidenced by their gestures, elicits particular responses from mothers, which, in turn, facilitate child learning (cf. Golinkoff, 1986).

Gesture is one way that children can indicate to their mothers what is uppermost in their minds. Note, however, that there are other ways – eye gaze, for example – that children can indicate their focus of attention to their mothers. If mother is attentive to where her child is looking, she can follow her child's gaze and establish joint attention with the child – a situation that turns out to be good for word-learning (Tomasello & Farrar, 1986). Mothers are likely to use whatever cues a child produces to make inferences about what is on the child's mind. By gesturing to an object in addition to looking at it, the child makes it clear that, at that moment, she is interested in communicating. Mother can thus calibrate her words to a child who is ready to hear them.

Note that mothers could be wrong about the intentions they attribute to a child on the basis of the child's gestures. Indeed, Golinkoff (1986) has shown that mothers often misinterpret their child's preverbal communications. However, the fact that maternal responses were related to later word- and sentence-learning in our study suggests that, on the whole, the mothers in our study were pretty good at guessing their child's meaning (otherwise we would not have found positive effects).

Gesture offers a mechanism by which listeners can calibrate their input to a child not only in the early

[7] This within-subject ANOVA was conducted on the five mothers who produced all four types of responses to their children's supplementary gesture+word combinations. Three additional mothers produced three of the four types of responses (they did not respond with information gleaned only from the child's gesture). The ANOVA conducted on these eight mothers was also significant ($F(2, 14) = 25.94$, $p < .0001$), as were the post-hoc tests, ps $< .0001$). The data from all 10 mothers are displayed in Figure 2.

stages of language-learning, but also at older ages and on other tasks. For example, children on the verge of learning a math task gesture differently from children who are not ready to learn that task (Perry, Church & Goldin-Meadow, 1988). And teachers take advantage of this signal, altering the instruction they give a child as a function of the gestures the child produces on the task (Goldin-Meadow *et al.*, 1999; Goldin-Meadow & Singer, 2003).

But do the responses adults make to children's gestures play a role in learning? The fact that mothers' translations were related to their children's later word- and sentence-learning in our study is suggestive, but cannot definitely prove that maternal responses to child gesture play a causal role in language-learning. We would need to experimentally manipulate responses to children's gestures to be certain, for example, responding with 'bird' after the child points to a bird, or with 'yes, the bird is taking a nap' after the child says 'nap' and points to the bird. Of course, even if effective, targeted input of this sort cannot be essential for language-learning since there are cultures in which adults do not directly address children (Ochs & Schieffelin, 1984). Nevertheless, gesture may prove to be one way that children can shape the language input they receive, thus facilitating their own learning.

In previous work, experimenters have tried to target responses to child utterances, responding to a child's utterance with an expansion of that utterance (Nelson, 1989), but without attending to whether or not the child gestured. Expansions of this sort sometimes lead to learning (Nelson, 1977; Nelson, Carskaddan & Bonvillian, 1973) but not always (Cazden, 1965), perhaps because it is difficult to know precisely what a child has in mind when she produces an incomplete utterance. By using a child's gestures to narrow down the range of possible expansions for a given utterance, both experimenters and mothers may be better able to target input to the child, thus making that input particularly effective.

Our results join others in suggesting that gesture can play a role in learning through its communicative effects. Learners signal through their gestures that they are in a particular cognitive state, and listeners adjust their responses accordingly. But gesture also has the potential to play a role in learning through its cognitive effects (cf. Goldin-Meadow & Wagner, 2005). For example, we have found that encouraging school-aged children to produce gestures conveying a correct problem-solving strategy increases the likelihood that those children will solve the problem correctly (Broaders, Cook, Mitchell & Goldin-Meadow, in press; Cook & Goldin-Meadow, 2006; Cook, Mitchell & Goldin-Meadow, in press). These findings suggest that the act of gesturing may itself play a role in learning. It is possible that, in toddlers, the act of referring to an object in gesture itself facilitates learning the word for that object. Our future work will explore whether gesture promotes language-learning not only by allowing children to elicit timely input from their language-learning environments (as we have shown here), but also by influencing their own cognitive state.

In sum, we have shown that the gestures a language-learning child produces have the potential to do more than reflect the child's readiness to learn new words and sentences – they may play a causal role in bringing about the acquisition of those new words and sentences. Mothers spontaneously translate their children's gestures into words, thus providing the children with a well-timed model for the words they need to hear. In this way, children use their hands to tell their mothers what to say next.

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